Experimental Study of Asphalt Concrete Strain Distribution in Flexible Pavements at the NAPTF

Presented to: 2014 FAA Worldwide Airport Technology Transfer Conference

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Date: August 6, 2014

ACKNOWLEDGEMENTS

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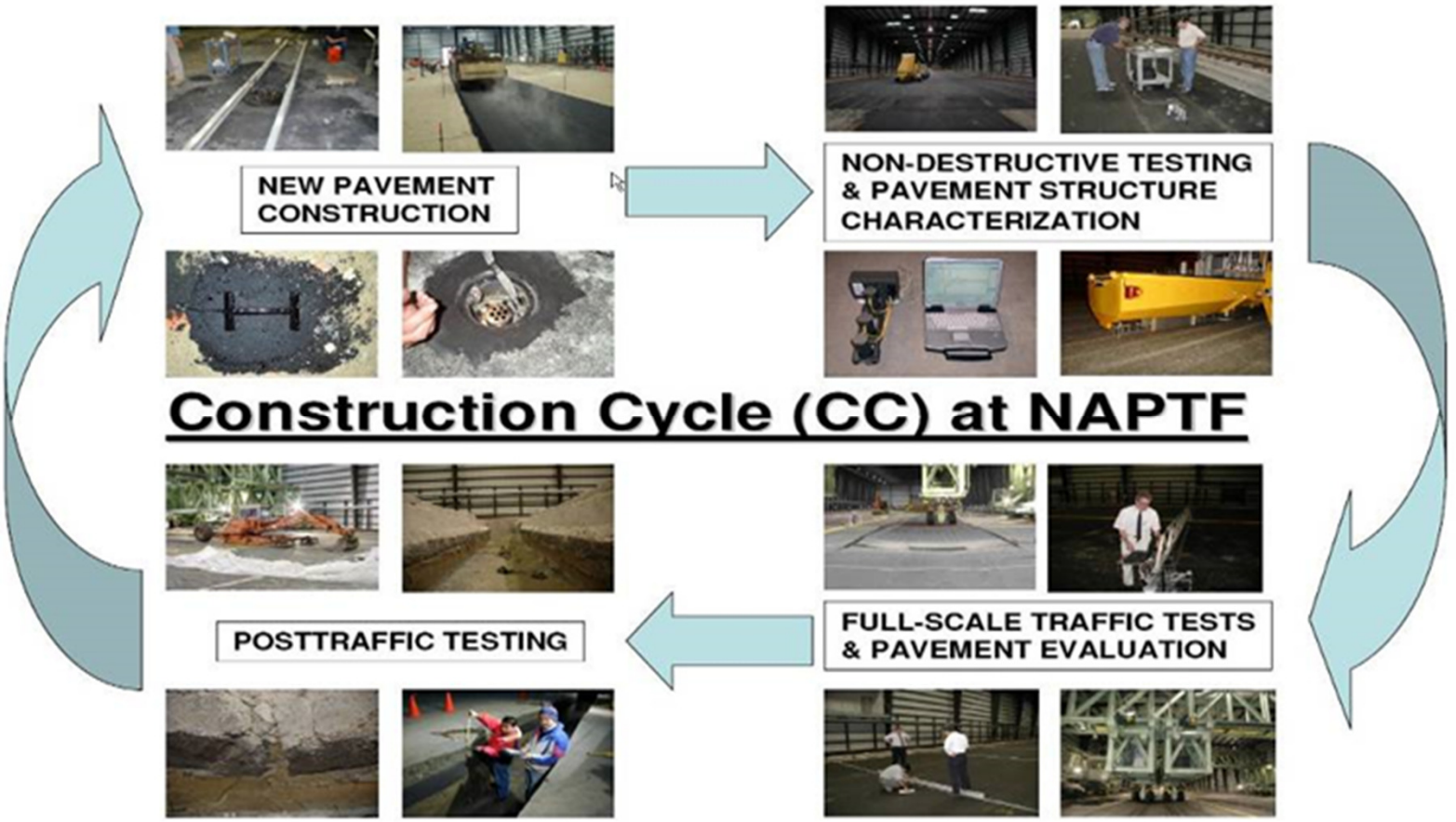
ACKNOWLEDGEMENTS

- FAA/SRA:
  - Murphy Flynn, FAA
  - Wilfredo Villafane, FAA
  - Sean Combs, SRA
  - Henry Fermin, SRA
  - Reynaldo Aponte, SRA
- Laval University:
  - Damien Grellet
- OpSens:
  - Charles Leduc


National Airport Pavement
Test Facility (NAPTF)

Construction Cycle at NAPTF



CONSTRUCTION CYCLE – 7 (CC-7)

PRIMARY OBJECTIVES

- Develop Perpetual Pavements Design criterion for airport pavements.
- Vertical strain threshold in the intermediate HMA layer to limit rutting.
- Horizontal strain threshold in the HMA base layer to prevent bottom-up fatigue cracking.
- Relationship between laboratory fatigue strain threshold and measured field HMA strains.
- Study strain distribution in the HMA layer.

CONSTRUCTION CYCLE – 7 (CC-7)

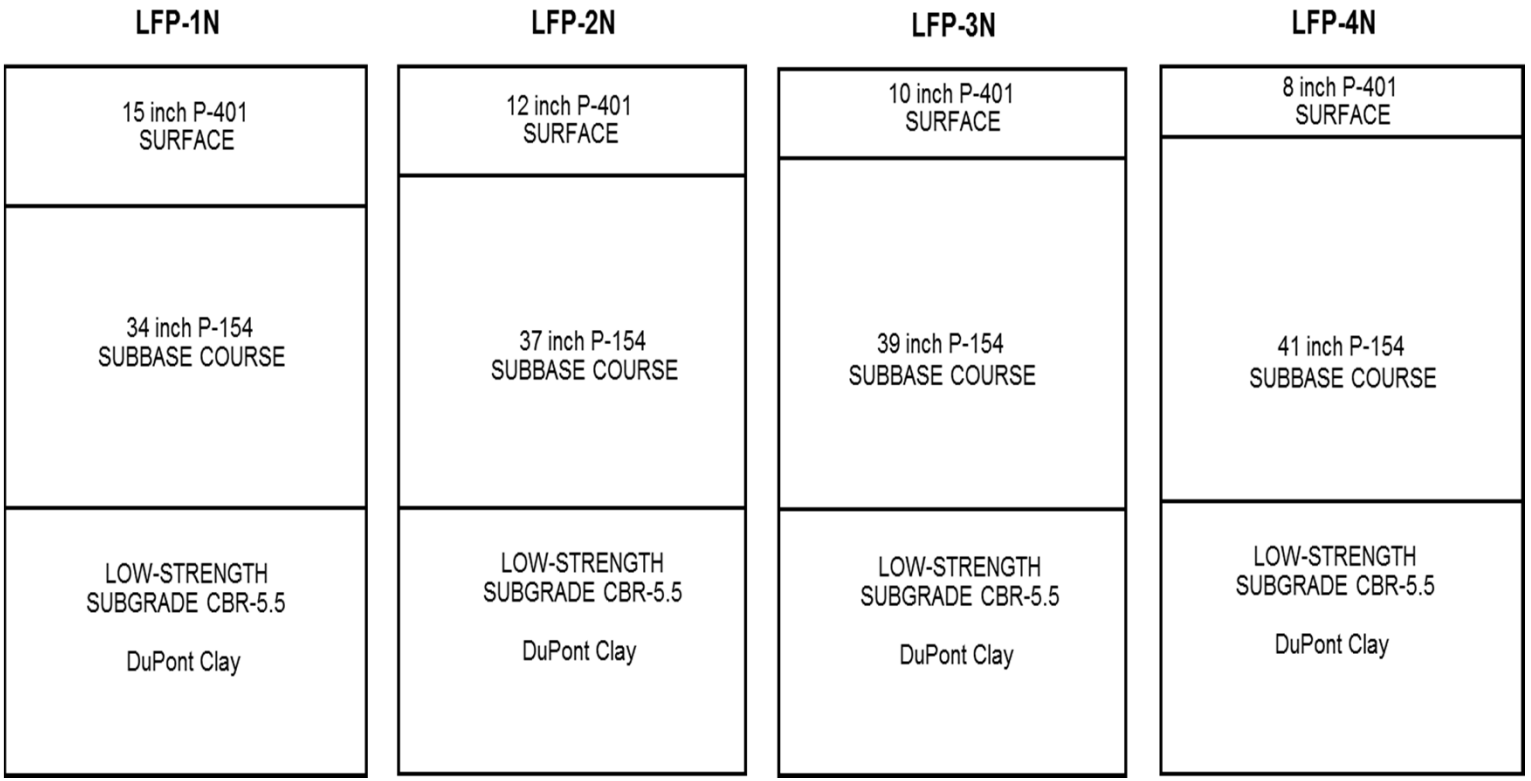
PRIMARY OBJECTIVES

- Verify/Refine/Modify fatigue model based on the ratio of dissipated energy change (RDEC)

- Overload (South Side Pavements)

  Determine allowable aircraft overload criteria for flexible pavement.

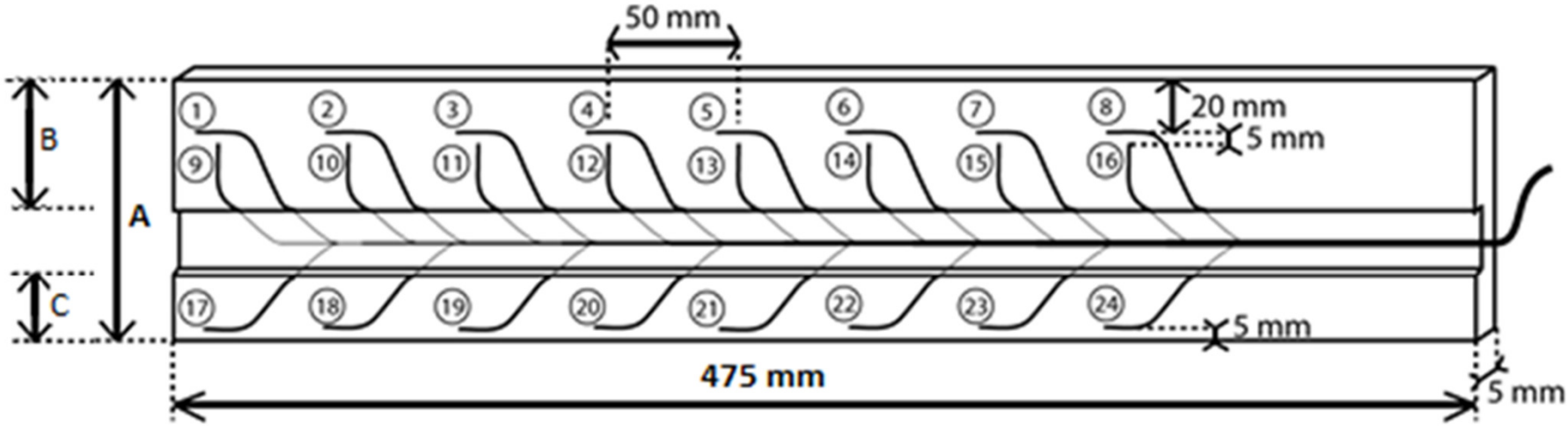
Pavement Cross Sections



Pavement Instrumentation

- H-Bar Strain Gages (ASG)
- Multiple Depth Deflectometers (MDD)
- Fiber Optic Strain Plates

Fiber Optic Strain Plate



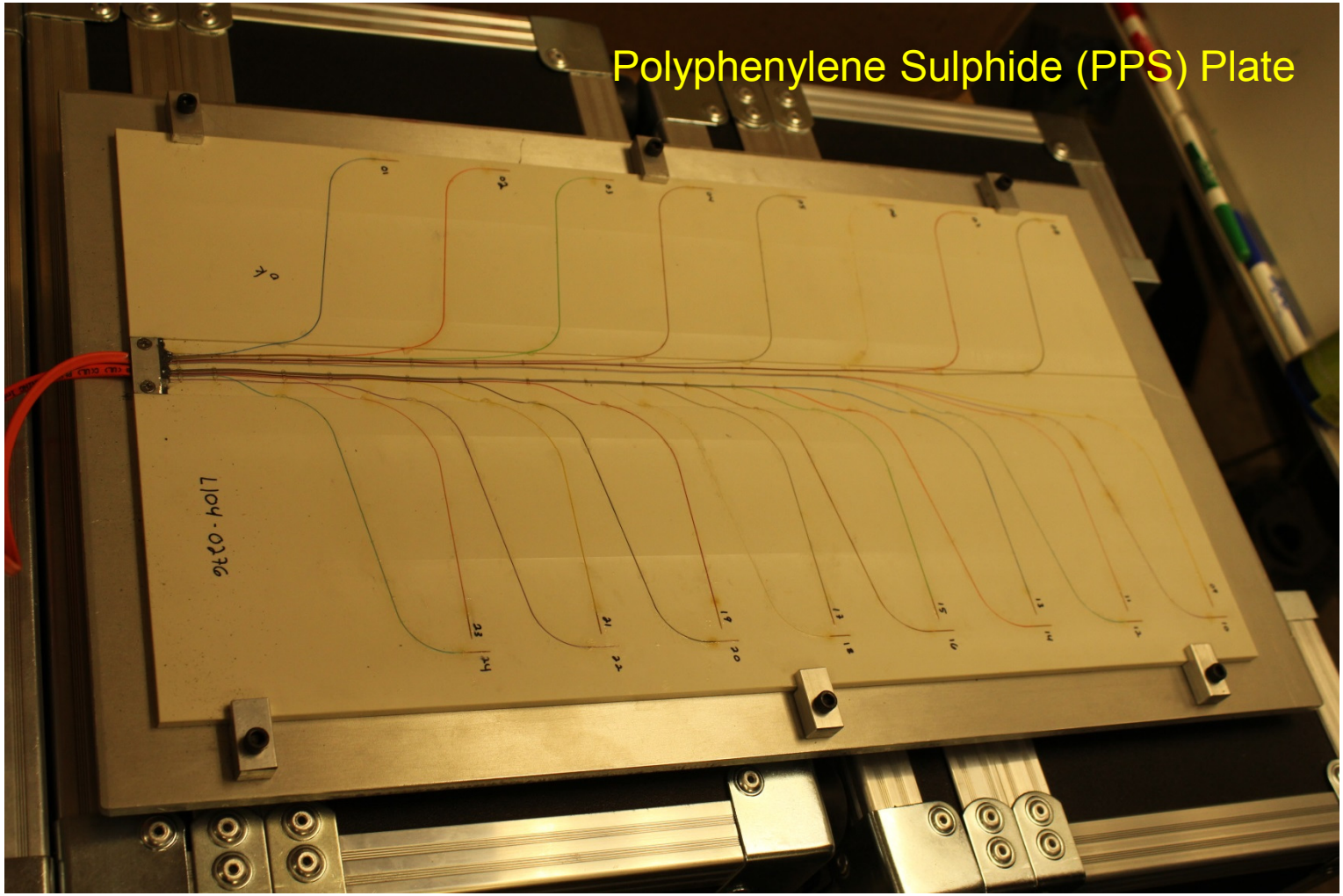
8" AC : A=203 mm / B=101.5 mm / C = 76.5 mm

10" AC : A=254 mm / B=127 mm / C=102 mm

12" AC : A=305 mm / B=152.5 mm / C = 127.5 mm

15" AC : A=381 mm / B=190.5 mm / C=165.5 mm

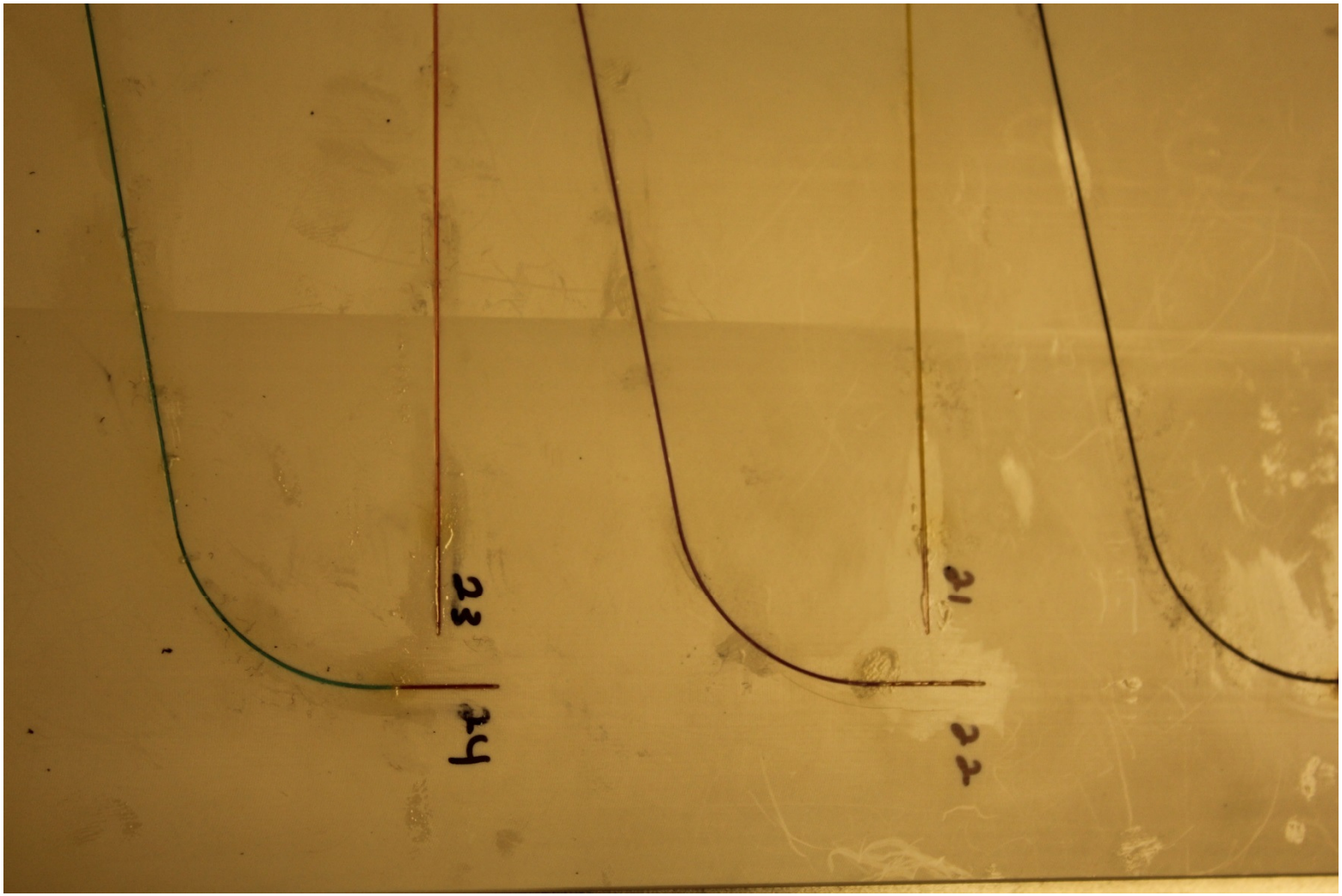
Fiber Optic Strain Plate



Fiber Optic Strain Plate - Principle

- White Light Polarization Interferometry
- Uses a signal conditioner to sense the path length difference inside a Fabry-Perrot interferometer of a known cavity length and delimited by two dielectric mirrors.
- The signal conditioner sends and receives the light, and the software interprets and transforms the received signal into physical quantitative values.

Fiber Optic Strain Plate - Principle



Fiber Optic Strain Plate - Installation

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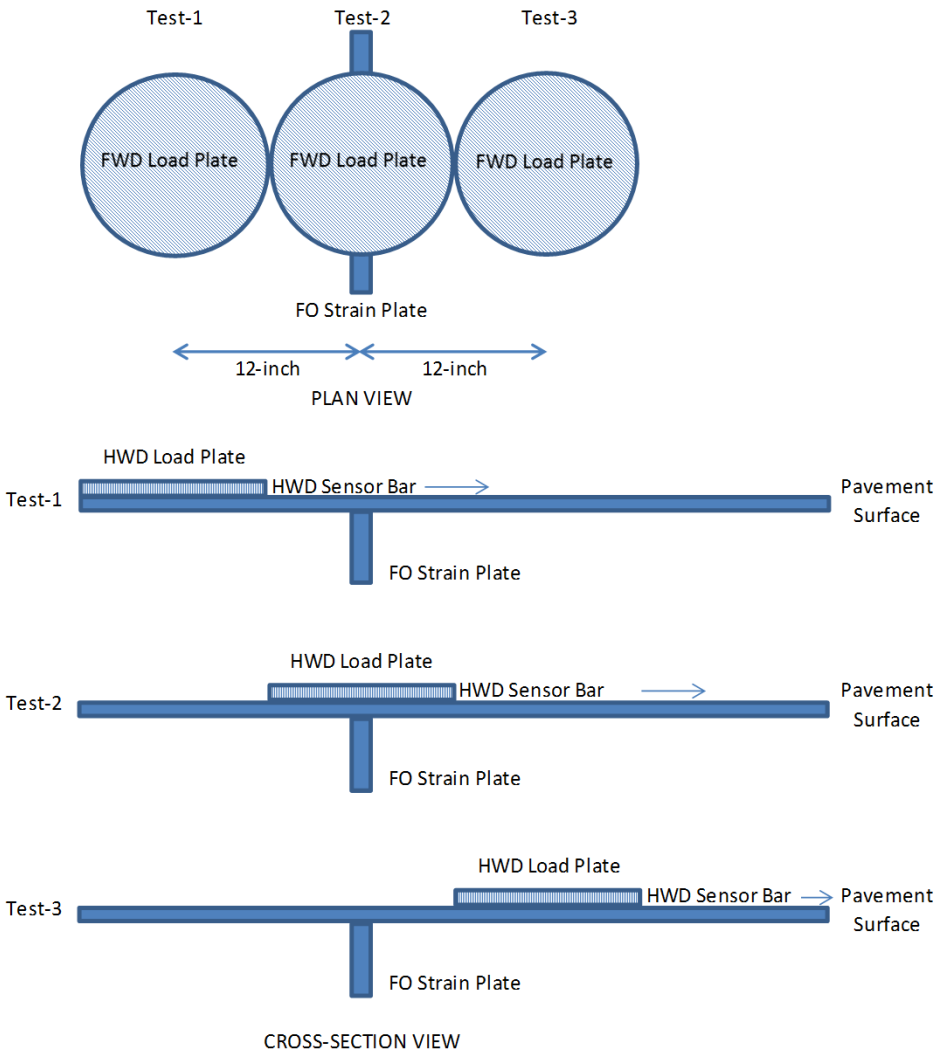
Heavy Weight Deflectometer (HWD) Tests

- Uniformity of pavement structure (6 locations in each test section).
- Effect of FOSP installation on pavement structure.

- 30.5-cm (12-inch) loading plate,
- a pulse width of 30 msec, and
- 4 drop heights consisting of a 160-kN (36-kips) "seating drop" followed by impact loads of 53, 106, and 160 kN (12, 24, and 36 kips).

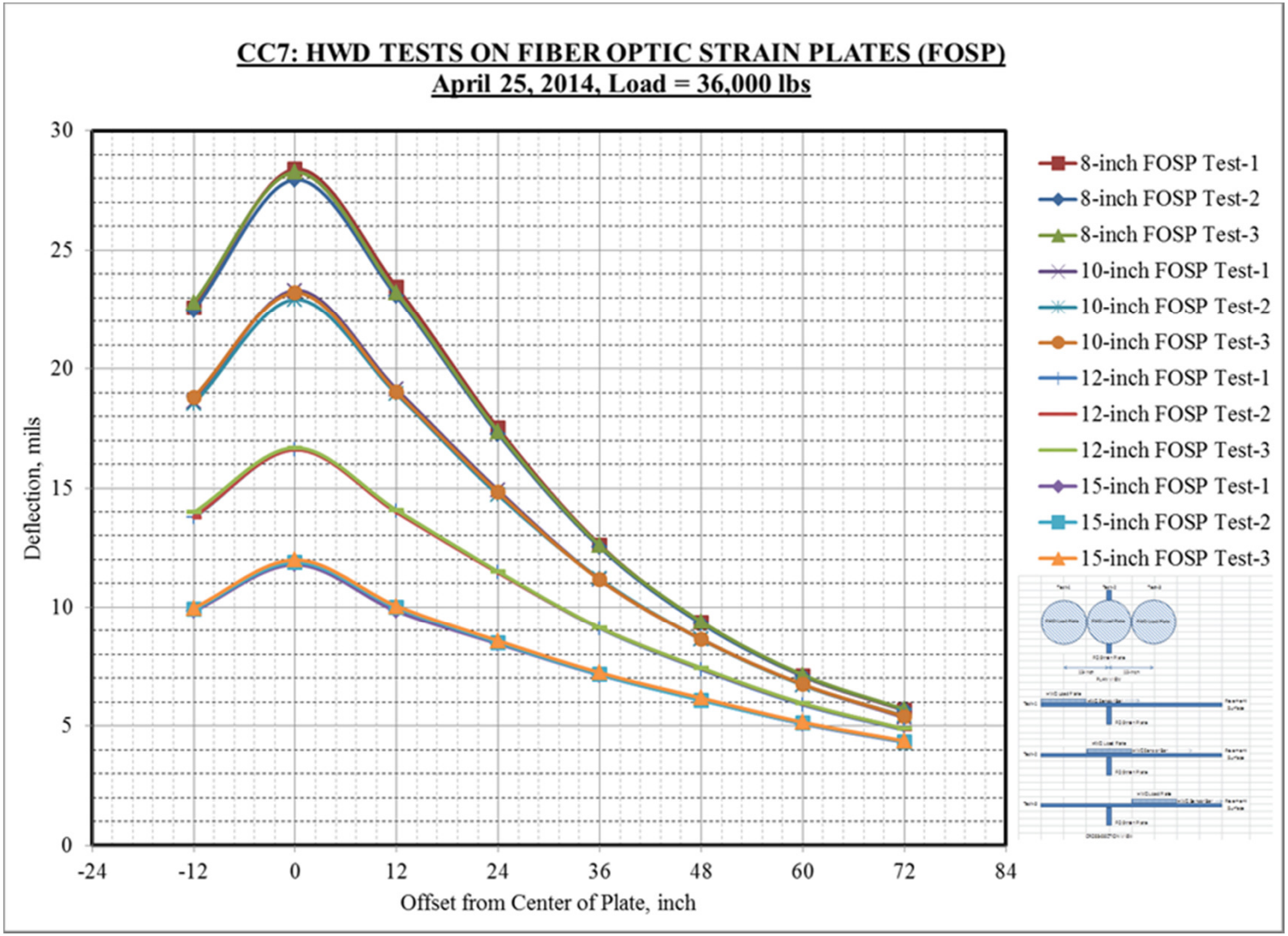
Heavy Weight Deflectometer (HWD) Tests



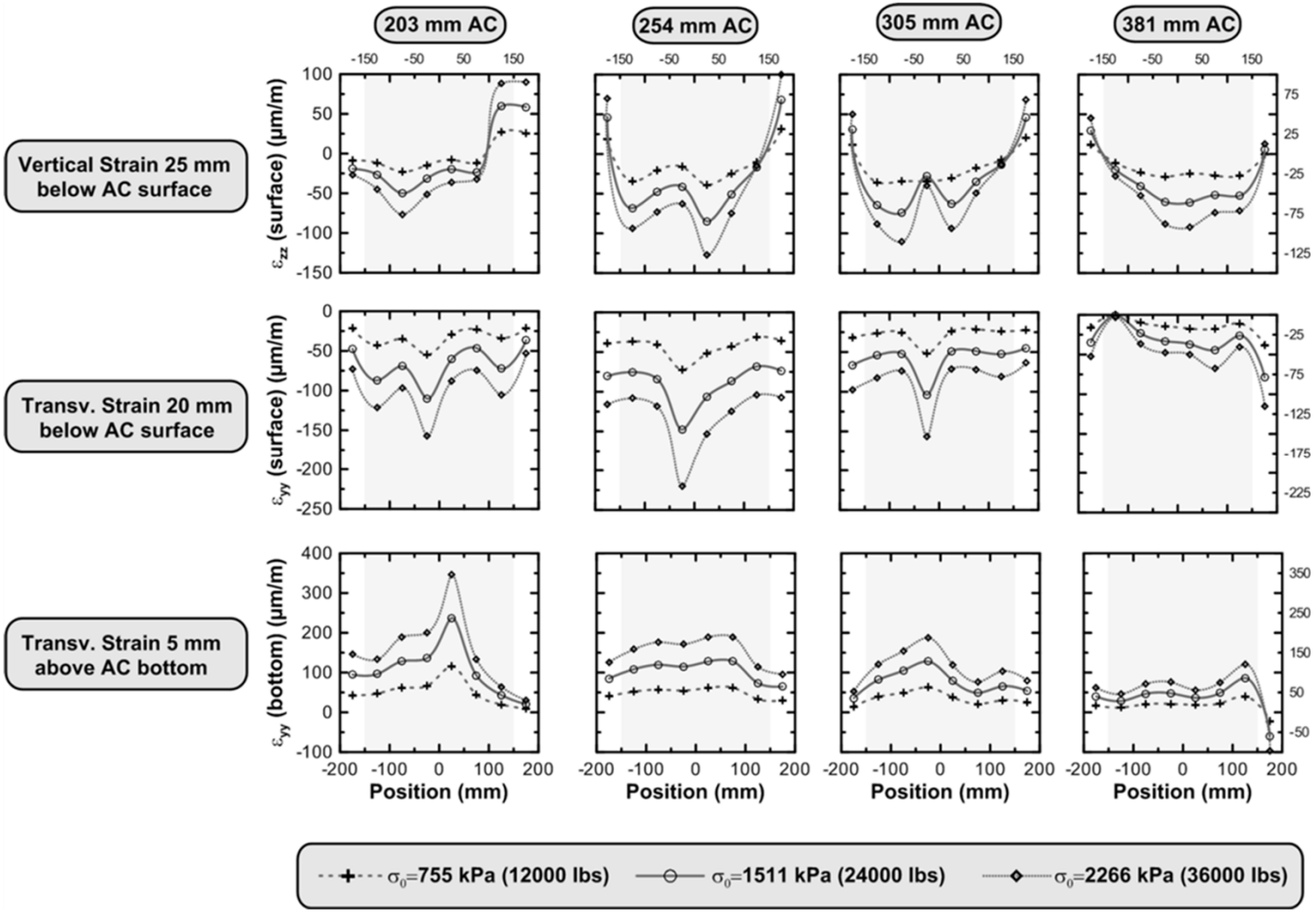
Heavy Weight Deflectometer (HWD) Tests

HMA Thickness, inch	HWD Test Section Summary				HWD Over FOSP		
		Deflection D0, mils	AREA, inch	ISM, kips/inch	Deflection D0, mils	AREA, inch	ISM, kips/inch
15	***Max.***	12.51	47.1	3133	11.89	45.35	3029
	Min.	11.49	45.8	2878			
	Mean	12.06	46.5	2988			
	Std. Dev.	0.39	0.6	97.7			
	COV, %	3.26	1.2	3.3			
12	***Max.***	17.07	44.8	2349	16.61	42.37	2168
	Min.	15.33	43.2	2109			
	Mean	16.19	43.9	2227			
	Std. Dev.	0.64	0.6	88.0			
	COV, %	3.94	1.5	4.0			
10	***Max.***	23.52	42.2	1786	22.92	38.92	1571
	Min.	20.15	39.6	1530			
	Mean	21.55	40.8	1674			
	Std. Dev.	1.15	0.8	87.1			
	COV, %	5.34	2.1	5.2			
8	***Max.***	29.16	38.5	1339	27.95	36.95	1288
	Min.	26.89	36.9	1235			
	Mean	27.83	37.8	1294			
	Std. Dev.	0.77	0.7	35.2			
	COV, %	2.77	1.8	2.7			

Heavy Weight Deflectometer (HWD) Tests



Fiber Optic Strain Plate - Responses



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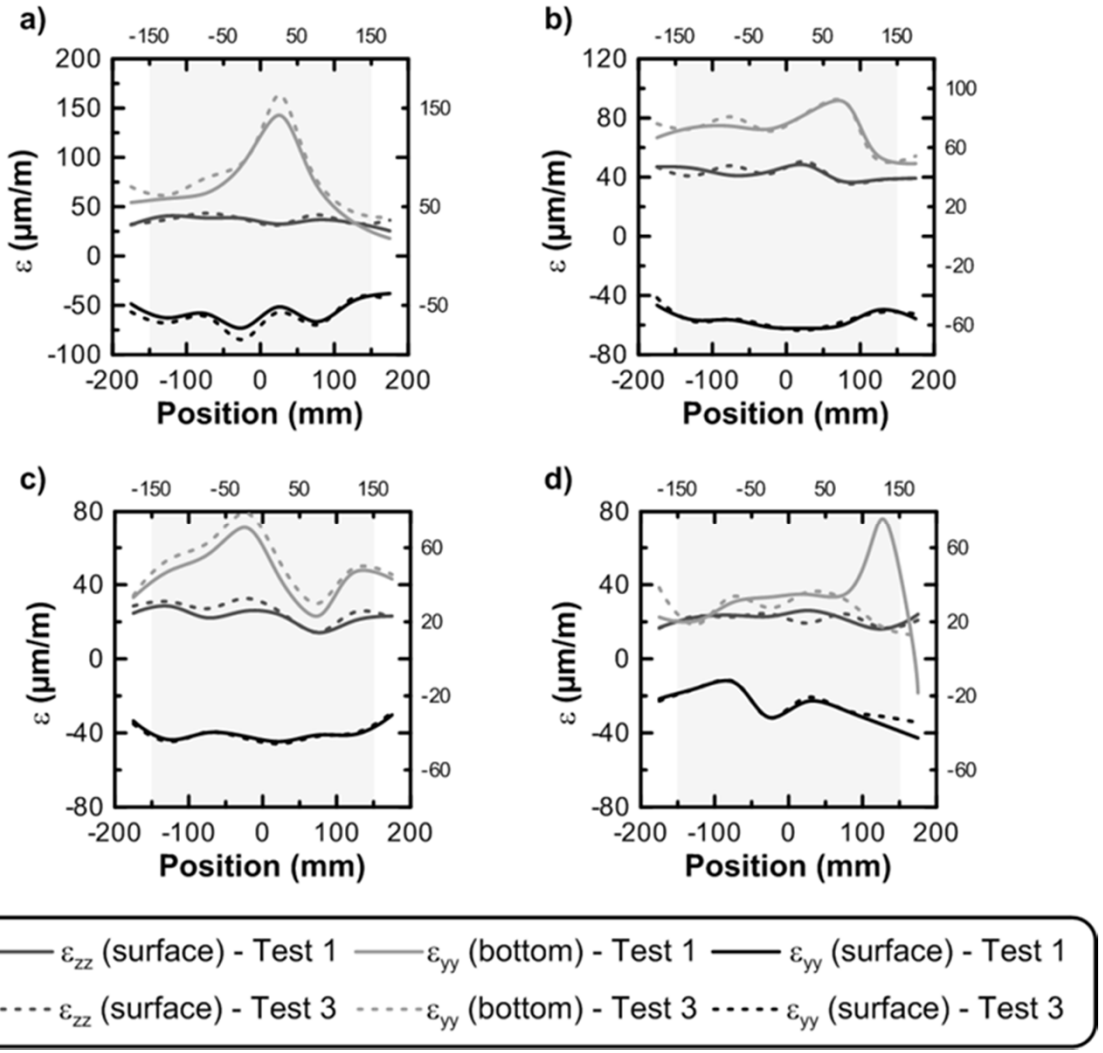

Summary:

- Asphalt concrete strains were measured using fiber optic strain plates installed post construction in the test sections.
- The strain plates allow for the measurement of near – surface compressive and tensile strains as well as tensile strains at the bottom of the AC layer over a 18-inch (45 cm) width across the wheel path.
- The HWD deflection measurements showed that the installation of strain plates does not alter the pavement structure significantly and forms an integral part of the pavement structure.

Summary:

- The strain plates are functioning as expected (except for some questionable results from one plate that will be subjected to additional tests for further evaluation).
- The asphalt concrete strain measurements made during traffic tests (to be conducted in the near future) under aircraft wheel loads (simulated at NAPTF) will be used for the validation/modification/refinement of the new HMA fatigue failure model (based on RDEC) incorporated in FAARFIELD (FAA pavement thickness design software).

Thank you!

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